Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

A MIOCENE FLORA FROM THE VIRGINIA COASTAL PLAIN[1]

EDWARD W. BERRY
Johns Hopkins University

The later Tertiary of Europe is as remarkable for its extensive and representative floras, as is that of America for their absence, for with the exception of certain isolated florules of the Western Interior and Pacific coast region there are no known Miocene floras in America.

The Atlantic coastal plain Miocene, or Chesapeake Group, appears to be made up entirely of marine deposits carrying an abundant, chiefly molluscan fauna and furnishing but slight hints of the life which flourished along its shores. It has been correlated on the basis of its invertebrates by Dall and others with the Helvetian or Middle Miocene of Europe. The earliest member of the Chesapeake Group, the Calvert formation, is characterized in the Maryland-Virginia region by extensive beds of diatomaceous earth which rest with marked unconformity on the usually glauconitic sands of the Eocene or overlapping them to a notable extent in Virginia.[2]

While the Miocene of the world was in general a period of elevation it would seem as if this elevation was greatest in eastern North America in the interval which preceded the deposition of the Chesapeake Group, during which time the Eocene appears to have undergone great denudation, since the comparative purity of the diatomaceous beds of the Calvert formation seems to have been due to the lowness rather than to the remoteness of the adjacent mainland with the consequent lack of erosion. This supposition is fully borne out by the evidence of the flora discussed in the following pages.

Some years ago the Maryland Geological Survey discovered plant remains in the Calvert formation as exposed on Good Hope Hill which is situated in the District of Columbia just across the Anacostia

[1] Published by permission of the Director of the U. S. Geological Survey.

[2] They of course rest on the older Cretaceous or the underlying crystallines in places where the Eocene is absent.

River from Washington. These were few and rather poor, but sufficient to form the basis for six species, all new, which were described by Dr. Arthur Hollick[1] in 1904. It is probable that an exhaustive search would disclose similar remains elsewhere in this immediate region, since the writer has seen fragmentary plant fossils from these same beds along the Bennings road near the District lines, and from the banks of the Choptank River and Tuckahoe Creek, on the Eastern Shore of Maryland. The only other eastern flora of possible Miocene age is that from the Bridgeton gravels of southern New Jersey which is understood to be quite extensive.[2] It also has been studied by Dr. Hollick but is as yet unpublished. It is considerably younger, however, than that of the Calvert formation and may possibly be of Pliocene age.

With these preliminary remarks we turn to a very interesting flora found in the Calvert formation at Richmond,. Virginia. The presence of this flora was discovered by Dr. Benjamin L. Miller during a reconnaissance trip in 1906, but no collections were made until the present summer when the writer spent part of two days in making a thorough collection at this locality and it is upon this collection that the following notes are based. The Calvert formation at this point consists of very argillaceous diatomaceous earth forty to fifty feet in thickness, resting unconformably upon remnants of the Eocene or upon the underlying crystallines and overlain by Pleistocene deposits. That this locality was near the shoreline of the Miocene sea, as it is near the landward limit of the existing Calvert deposits, is indicated not only by the argillaceous nature of the materials as compared with similar diatomaceous deposits elsewhere in the Calvert formation, but by the contained plant fossils, as well as by considerable comminuted lignite, the latter forming layers 5-12 mm. thick in places.

Thirteen species are enumerated in the present communication and the doubtful fragments uncharacterized at this time include perhaps two or three more forms in addition to several varieties of seeds not yet identified. The species recognized include seven well-known and widespread Tertiary forms and one species, *Rhus milleri*

---

[1] Hollick, "Miocene," *Maryland Geol. Surv.*, 1904, pp. 483-86, Figs. *a-h*.

[2] A Miocene flora of considerable variety and extent, discovered within the last few months in North Carolina, is being studied by the writer at the present time.

Hollick, previously described from the Calvert formation of Maryland. Six species are described as new.

It seems evident that this is a localized flora and not one characteristic of the eastern American uplands during Miocene time, and we may compare the local conditions at that time with those which exist at the present day in the Dismal Swamp region, or, better still, with the innumerable cypress swamps which skirt the South Atlantic coast. There is the Miocene cypress (*Taxodium*) by far the most abundant fossil in these deposits and associated with it we find *Salvinia*, a floating plant in the modern flora. The seeds of a *Nyssa* represent that modern semi-aquatic genus. *Carpinus* and *Planera* are both low swamp and waterside types at the present day, as are a majority of the willows (*Salix*). *Platanus* inhabits wet situations as do also several species of *Fraxinus* and many species of *Ficus*. The oak (*Quercus*) is at home in the environment pictured, while the *Rhus*, *Celastrus*, and the two species of Leguminoseae are not at all out of place in such an association. The conclusion seems irresistible that in these fossiliferous Calvert deposits we have preserved some of the débris of a nearby cypress swamp, and that it was the presence of such swamps along the consequently low-lying coast where the streams were of necessity inactive, which effectually prevented any large amount of land-derived sediment from becoming a part of the Calvert formation. Citations are restricted to the more important references in the following notes:

Subkingdom Pteridophyta
Order FILICALES
Family *Salviniaceae*
Genus Salvinia Adans
SALVINIA FORMOSA Heer ?

Salvinia formosa Heer, Fl. Tert. Helv., 3:156. pl. 145. f. 13–15. 1859.
Velenovsky, Fl. Ausgebr. Tert. Letten v. Vrsovic, 12. pl. 1. f. 14–17. 1882.
Hollick, Bull. Torrey Club, 21:256. pl. 205. f. 6. 1894.
Zeiller, Fl. Foss. Gites de Charbon du Tonkin, 269. pl. 51. f. 2, 3. 1903.

This undoubted fragment of a Salvinia leaf has been doubtfully referred to the above species, with which it agrees in so far as its characters can be made out, rather than to adopt the course of founding a new species upon a single fragmentary specimen. Future collections may furnish sufficient material for a complete diagnosis in which case the specific identity can be positively settled.

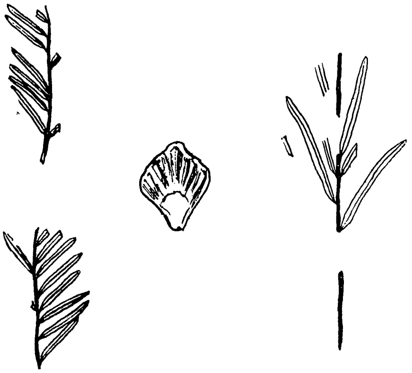

FIG. 1

Subkingdom Spermatophyta
Class GYMNOSPERMAE
Order CONIFERALES
Family *Pinaceae*
Subfamily *Taxodieae*
Genus Taxodium Rich.
TAXODIUM DISTICHUM MIOCENUM Heer

Taxodites dubius Sternb., Fl. d. Vorwelt, 204. 1838.
Unger, Iconogr., 20. pl. 10. f. 1–7. 1852.
Taxodium dubium Heer, Fl. Tert. Helv., 1:49. pl. 17. f. 5–15; 1855.
Taxodium distichum miocenum Heer, Mioc. Baltic Fl., 18. pl. 2; pl. 3. f. 6, 7. 1869.
Newb., Mon. U. S. Geol. Surv., 35:22. pl. 47. f. 6; pl. 51. f. 3; pl. 52. f. 2–4; pl. 55. f. 5. 1898.
Knowlton, Bull. U. S. Geol. Surv., No. 204:27. 1902.
Harriman Rept., 4:152. 1904.

This is by far the commonest fossil in these deposits indicating that the nearby shores were probably bordered by cypress swamps, thus furnishing a plausible explanation for the absence of terrigenous materials in the Calvert formation.

It is an exceedingly common and widespread Tertiary species ranging from the Eocene upward into the basal Pliocene (Messinian) and recorded from numerous localities throughout Eurasia from Japan and the Kirghiz Steppe to Italy, Prussia, France, and Switzerland. In the Arctic regions it has been found in Alaska, Grinnell Land, and Greenland, and in the United States it is recorded from Nevada, Wyoming, Montana, and Oregon.

It may be distinguished from the equally wide-ranging *Sequoia langsdorfii* by the markedly decurrent leaves of the latter.

The collection made at Richmond include, in addition to the leafy twigs, the characteristic cone-scale figured, which is slightly smaller than the usual scales of the existing species but otherwise exactly similar.

Class Angiospermae

Order SALICALES
Family *Salicaceae*
Genus Salix Linné
SALIX RAEANA Heer

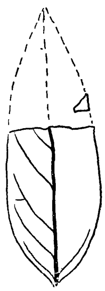

FIG. 2

Salix raeana Heer, Fl. Foss. Arct., 1:102, 139. pl. 4. f. 11–13; pl. 21. f. 13; pl. 47. f. 11. 1868.
Ibid., 2. ab. 4:469. pl. 43. f. 11a. 1871.
Ibid., 4. ab. 1:70. pl. 14. f. 8. 1877.
Ibid., 7:76. pl. 69. f. 2; pl. 86. f. 4. 1883.
Lesq., Proc. U. S. Natl. Mus., 11:17. 1888.
Knowlton, Bull. U. S. Geol. Surv., No. 204: 30. 1902.

The basal portions (about one-half) of two leaves of a Salix were found at Richmond, and, although incomplete, they agree so admirably with the numerous figures of this species given by Heer as to leave little doubt of their specific identity. They indicate a mediumly broad lanceolate leaf 3.5 cm. long by 1.3 cm. in greatest width, which was toward the somewhat rounded base.

This species was described originally from Greenland by Heer who afterward detected it in material from Spitzbergen, and in the Tertiary collection from near the north of the Mackenzie River made by Sir John Richardson's expedition. Lesquereux afterward identified it from the Mascall beds of Oregon, basing his determination upon material which Dr. Knowlton states (*loc. cit.*) is very poor and doubtful.

Order FAGALES
Family *Betulaceae*
Genus Carpinus Linné
CARPINUS GRANDIS Unger

Carpinus grandis Unger, Syn. Pl. Foss., 220. 1845.
Heer, Fl. Tert. Helv., 2:40. pl. 71. f. 19b–e; pl. 72. f. 2–24; pl. 73. f. 2–4. 1856.
Fl. Foss. Arct., 1:103. pl. 49. f. 9. 1868.
Ibid., 2:469. pl. 44. f. 11c. 1871.
Ibid., 3. ab. 2:14, 17. pl. 3. f. 14. 1874.
Ibid., 7:82. pl. 88. f. 4, 5. 1883.
Lesq., Tert., Fl., 143. pl. 19. f. 9; pl. 64. f. 8–10. 1878.
Velenovsky, Fl. Ausgebr. Tert. Letten v. Vrsovic, 23. pl. 2. f. 25; pl. 3. f. 1–6. 1882.
Knowlton, Bull. U. S. Geol. Surv., No. 204:38. 1902.

This is another of those widespread Tertiary species which may be composite although usually regarded as simply a variable type. The Richmond collections contain eight fragments of leaves which are referred with some little hesitation to this species. The venation is similar, although it must be admitted that it would serve equally well for Fagus, Betula, Ostrya, or Planera; the variability in size is in accord with that usually observed in this species as is also the general outline. Unfortunately the marginal characters, while they suggest this form, are not well enough preserved to be decisive, all of the leaves being macerated in exactly the same manner as are the delicate leaves of *Carpinus caroliniana* Walt. after they have floated down our southern rivers for a considerable distance.

Carpinus grandis makes its appearance in the Arctic Tertiaries, becoming rather widespread before the close of the Oligocene and is recorded from Europe, Asia, and America. It is more especially, however, a Miocene type and has been collected from a large number of European localities as well as from Japan and the Mascall beds of the John Day basin in Oregon. It persists into the Pliocene, being recorded from beds of that age in Styria and in Italy (Messinian).

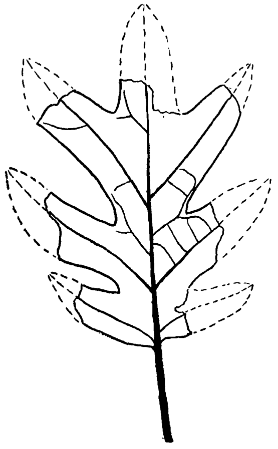

FIG. 3

Family *Fagaceae*

Genus Quercus Linné

QUERCUS MILLERI sp. nov.

Leaves about 5 cm. in length with a mediumly stout petiole 1.4 cm. long. Lobate, with three narrow rather obtusely pointed lobes on each side, each traversed by a prominent secondary whose angle of divergence is less than that of the lobes, the secondaries leaving the midrib nearly on a line with the basal margin of the lobes and running nearer their upper than their lower margin to the apex of the lobe. Basal lobes forming almost a right angle with the midrib, their lower margins being very obtusely rounded, almost truncated, to within a millimeter or two of the petiole and then curving slightly downward, their secondaries branching at an angle of 55° about one millimeter above the top of the petiole, subopposite. The sinus which intervenes between the basal and the median lateral lobes is cut to within 4 or 5 mm. of the midrib and is narrow and acute and but slightly inclined. The median lateral lobes which are 50 per cent. longer than the basal pair, and also broader, are somewhat more ascending, the angle of divergence of their secondaries from the midrib being 46°. The next sinus is somewhat broader, widening out laterally. It is about the same depth as the lower sinus, terminating internally in a narrow obtuse point. The upper lateral lobes are about the same length as the median pair, but are more ascending, their secondaries diverging from the midrib at an angle of from 35° to 42°. The terminal lobe is 9 mm. wide at its base and of undeterminate length, probably about 1.5 cm., the sinus between it and the upper lateral lobes being broad and almost straight sided, terminating internally in an obtuse point. The leaf texture was somewhat coriaceous and the tertiaries were camptodrome and of the usual Quercus type.

This species is based upon two specimens with their counterparts, the more perfect of which is figured, the other being slightly larger and showing the obtuse terminations of the lobes, supplying these parts which are missing in the figured specimen.

This is a rather handsome oak abundantly distinct from the forms heretofore known, and it is named in honor of Dr. Benjamin L. Miller who discovered the locality from which the collections were made.

Order URTICALES
Family *Ulmaceae*
Genus Planera J. F. Gmelin
PLANERA UNGERI Ettings

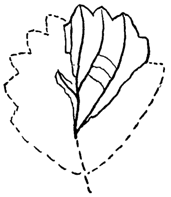
FIG. 4

Planera ungeri Ettings., Foss. Fl. v. Wien, 14. pl. 2. f. 5–18. 1851.
Heer, Fl. Tert. Helv., 2:60. pl. 80. 1856.
Fl. Foss. Arct., 2:472. pl. 45. f. 5a, c; pl. 46. f. 6, 7a, 1871.
Ibid., 5. ab. 6:53. pl. 15. f. 19; ab. 7:40. pl. 9. f. 10; pl. 10. f. 1, 2. 1878
Ibid., 7:94. pl. 75. f. 11; pl. 89. f. 9; pl. 92. f. 9; pl. 95. f. 6. 7; pl. 97. f. 3. 1883.
Kovats, Foss. Fl. v. Erdöbénye, 27. pl. 5. f. 1, 2; pl. 6. f. 1–6. 1856.
Lesq., Tert. Fl., 190. pl. 27. f. 7. 1878.

Velenovsky, Fl. Ausgebr. Tert. Letten v. Vrsovic, 26. pl. 3. f. 18–23; pl. 4. f. 14. 1882.
Friedrich, Beitr, Tertfl. Sachsen, 164. pl. 26. f. 2, 3. 1883.
Knowlton, Bull. U. S. Geol. Surv., No. 204:55. 1902.

Fragments of this ubiquitous species are fairly common at Richmond, the one figured being the most definite. It indicates a somewhat more orbicular leaf than the majority of leaves of this species but may be compared with several Greenland leaves which Heer identifies as *Planera ungeri.*[1] The marginal teeth and venation are identical with those of more complete specimens from European Tertiary localities and the implied environmental conditions were also most suitable. There is some resemblance to the Mascall species *Betula ? dayana* of Knowlton[2] and also to the Tortonian *Betula weissii* Heer[3] of Europe.

Planera ungeri has a recorded range from the Eocene into the Pleistocene and a distribution from Manchuria and Japan through Asia and Europe to Colorado and Oregon, occurring also in Greenland and Iceland. It is quite possible that more than one species may be included under this name but if such is the case their proper segregation is still a task for the future.

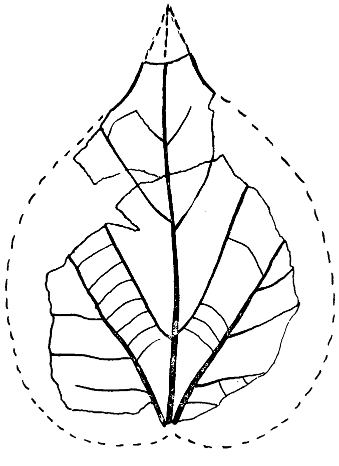

FIG. 5

Family *Moraceae*
Genus Ficus Linné
FICUS RICHMONDENSIS sp. nov.

Leaves apparently cordate in outline, about 5 to 6 cm. long by 5 cm. in greatest width, acuminate, entire. Venation palmate, the lateral primaries of somewhat less caliber than the midrib, from which they diverge at an acute angle (about 30°) at or near its base. The midrib gives off three pairs of secondaries above the lateral primaries and these are apparently camptodrome. Tertiaries numerous, but slightly curved, transverse. Lateral primaries giving off externally three or four nearly straight branches.

---

[1] Cf. Heer, Fl. Foss. Arct., 7. pl. 89. f. 9; pl. 95. f. 7. 1883.

[2] Knowlton, U. S. Geol. Surv., *Bull. No. 204,* 41, pl. 4, f. 4, 1902.

[3] Heer, Fl. Tert. Helv., 2:39, pl. 71, f. 24, 1856.

The fossils, like the recent species of Ficus, are very numerous and range from the Cretaceous upward. The present species is based on the single imperfect specimen figured, which seems to be referable to this genus although the allied genus Celtis suggested itself. A rather similar form from Florissant, Colorado, is doubtfully referred by Cockerell to the genus Morus.[1] The entire margin is a more constant character in Ficus than it is in either of these other genera and the venation is closer to that of the leaves usually referred to Ficus, which facts have largely determined the present identification.

Order ROSALES

Family *Platanaceae*

Genus Platanus Linné

PLATANUS ACEROIDES Goeppert?

Platanus aceroides Gœpp., Zeit. Deutsch. Geol. Gesell., 4:492. 1852.
Lesq., Am. Journ. Sci. (ii). 45:206. 1869.
Tert. Fl., 184. pl. 25. f. 4–6. 1878.
Proc. U. S. Natl. Mus., 11:19. pl. 5. f. 7. 1888.
Heer, Fl. Tert. Helv., 2:71. pl. 87. f. 1–11; pl. 88. f. 5–12, 15. 1856.
Fl. Foss. Arct., 1:111. pl. 12. f. 1–8; pl. 47. f. 3. 1868.
Knowlton, Bull. U. S. Geol. Surv. No. 204, 65. 1902.
Hollick, Md. Geol. Surv., Pli. & Pleist., 231. pl. 73; 74. 1906.

Two fragments of Platanus leaves showing neither the outline nor margin, but containing parts of two secondaries with the characteristic tertiary venation of this genus, were found at Richmond. Their specific affinity cannot be made out with certainty, and they are referred to this species with some hesitation. The tentative determination is made on the ground of the abundance of this species elsewhere at this time, and also immediately before and afterward. As far as the specimens will permit of comparison they agree perfectly with this form.

Family *Caesalpiniaceae*

Genus Podogonium Heer

PODOGONIUM? VIRGINIANUM sp. nov.

In the absence of the characteristic pods this generic reference can only be tentative. The species is based on a small rather thick leaflet,

---

[1] Cockerell, *Bull. Am. Mus. Nat. Hist.*, Vol. XXIV 1908, p. 88, pl. vii, fig. 19.

8 mm. in length by about 3 mm. in breadth, with a rounded-truncate apex and a somewhat narrowed acute base. Of the venation only the midrib is discernable.

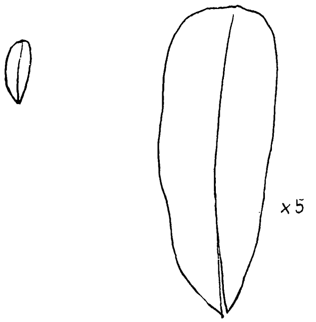

FIG. 6

The genus *Podogonium* is entirely extinct and is referred by Heer and others to the Caesalpiniaceae although Unger placed it in the Papilionaceae. In all there are about a dozen species, all Tertiary and ranging in age from the basal Eocene to the basal Pliocene (Messinian). It is chiefly European with but two species recorded from America. Five species have been found in the Tortonian of Europe.

Family *Papilionaceae*
Genus Dalbergia Linné f.
DALBERGIA CALVERTENSIS sp. nov.

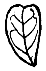

FIG. 7

Leaflets small, 8 mm. long by 4.5 mm. in greatest width, which is toward the apex, obovate in outline with an emarginate to retuse apex and gradually narrowed acute base. Secondaries three pairs, opposite, ascending, camptodrome.

There are upward of eighty species of *Dalbergia* in the modern flora ranging through the tropics of both the old and the new worlds. The genus is abundantly represented during the Mid-Cretaceous by five or more species in Greenland and on the North American mainland. In Europe it is rather common during the Tertiary, Heer describing no less than four species from the Tortonian. There are also ten or a dozen species recorded from various European Oligocene localities.

Order SAPINDALES
Family *Celastraceae*
Genus Celastrus Linné
CELASTRUS BRUCKMANNI Al. Br.

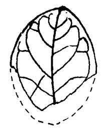

FIG. 8

Celastrus bruckmanni Al. Br., in Stizenb. Verzeich., 87. 1851.
Heer, Fl. Tert. Helv., 3:69. pl. 171. f. 27–38. 1859.
Fl. Foss. Arct., 6. ab. 1:14. pl. 6. f. 5. 1880.
Ibid., 7:130. pl. 84. f. 9. 1883.
Gaudin, Contrib., 6:22. pl. 3. f. 6. 1862.
Rhamnus parvifolius Web., Palaeont., 4:154. pl. 27. f. 16. 1855.

This nearly complete elliptical leaf closely resembles the leaves usually referred to this species, although suggestive of the leaflets of a number of species of the Papilionaceae. It is about 1.6 cm. long by 1.2 cm. in greatest width, with four or five pairs of camptodrome secondaries.

Celastrus bruckmanni was recorded originally from the Tortonian of Baden and has since been found at a number of European localities, some ranging as low as the Aquitanian. It is recorded by Heer (*loc. cit.*) from the Greenland Tertiary, but has not heretofore been found on the North American mainland.

Family *Anacardiaceae*
Genus Rhus Linné
RHUS MILLERI Hollick

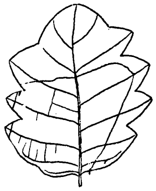

FIG. 9

Rhus milleri Hollick, Md. Geol. Surv., Miocene, 485. f. lc, d. 1904.

This species which was described by Hollick a few years ago from the Calvert formation of the District of Columbia is represented by fragmentary specimens in the Richmond material.

In some respects these leaves suggest a relationship with *Myrica*, but the available material is so scanty that it is not desirable to make any change in the nomenclature. The missing parts in the figure have been restored from the more complete Maryland material, the outline of the Virginia specimen being indicated.

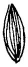

FIG. 10

Order UMBELLALES
Family *Cornaceae*
Genus Nyssa Linné
NYSSA GRACILIS sp. nov.

This species is based on a lanceolate, somewhat two-sided terete stone with about fifteen very narrow longitudinal ridges, possibly the remnants of slender wings. Length 8 mm., greatest diameter 2.5 mm., about equally pointed at both ends. The existing species of Nyssa number less than a dozen, inhabiting the warm temperate region of eastern North America and eastern and central Asia. A great many fossil species, founded chiefly upon stones, have been described, Perkins alone describing no less than eighteen species, an altogether too large a number, from the Tertiary lignites of Brandon, Vermont. Leaves of two supposed species have been described from the Dakota Group and leaves and stones have been recorded from a large number of European localities, chiefly of Oligocene and Miocene ages.

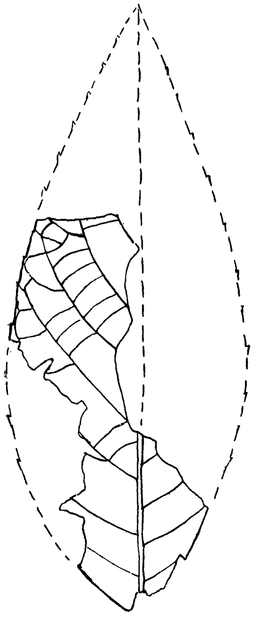

FIG. 11

Order GENTIANALES
Family *Oleaceae*
Genus Fraxinus Linné

FRAXINUS RICHMONDENSIS sp. nov.

Leaflets ovate in outline with a somewhat acuminate (?) apex and a rather rounded acute base, about 8 cm. long by 3.25 cm. in greatest width. Margin with very small remote serrate teeth. Secondaries ten or twelve pairs branching from the midrib at angles ranging from 65° for the basal pair to 40° for those in the apical part of the leaf, curving slightly upward, parallel, their tips joined by rounded festoons with the adjacent secondaries and sending off short curved branches to the marginal teeth. Balance of the tertiaries straight, transverse.

This species is based on the incomplete leaflet figured and its counterpart, and resembles both in size and outline the leaflets of the existing white (*Fraxinus americana* Linné) and red ash (*Fraxinus pennsylvanica* Marsh).